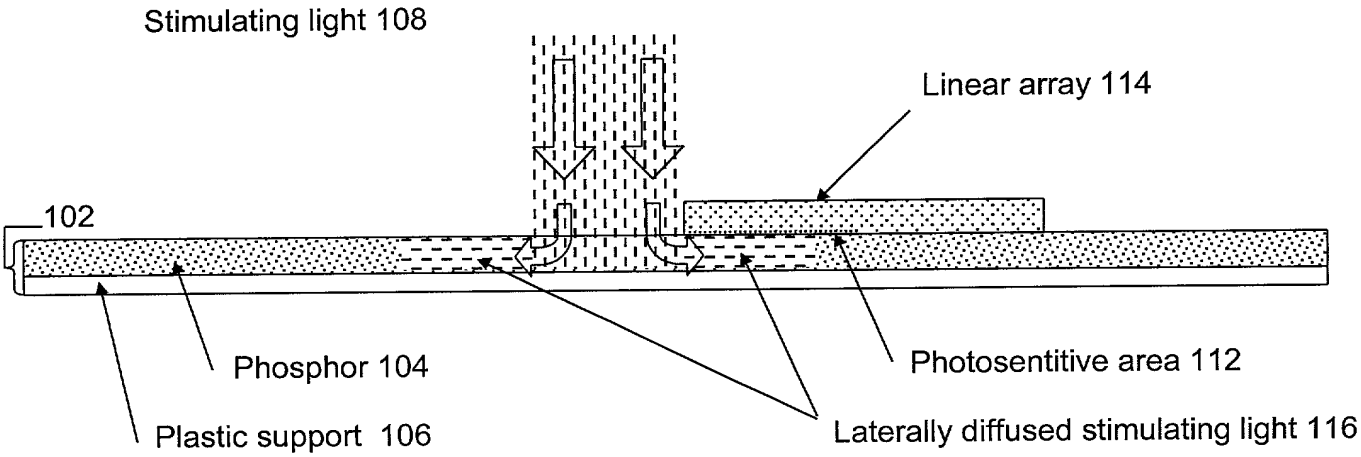

Stimulating light 108
Linear array 114
102
Phosphor 104
Photosentitive area 112
Plastic support 106
Laterally diffused stimulating light 116

Fig.1

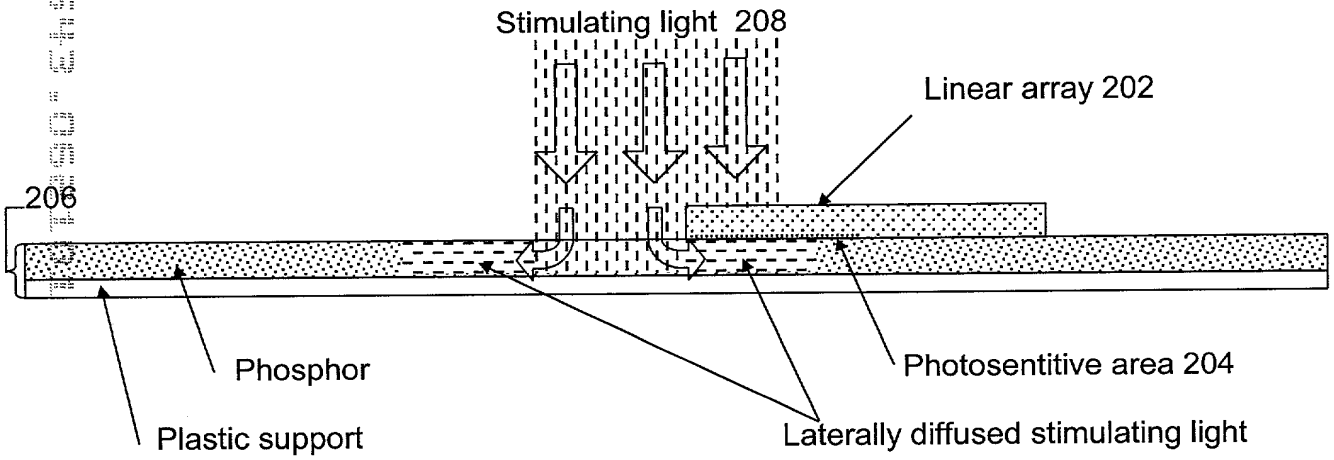

Stimulating light 208
Linear array 202
206
Phosphor
Photosentitive area 204
Plastic support
Laterally diffused stimulating light

Fig.2

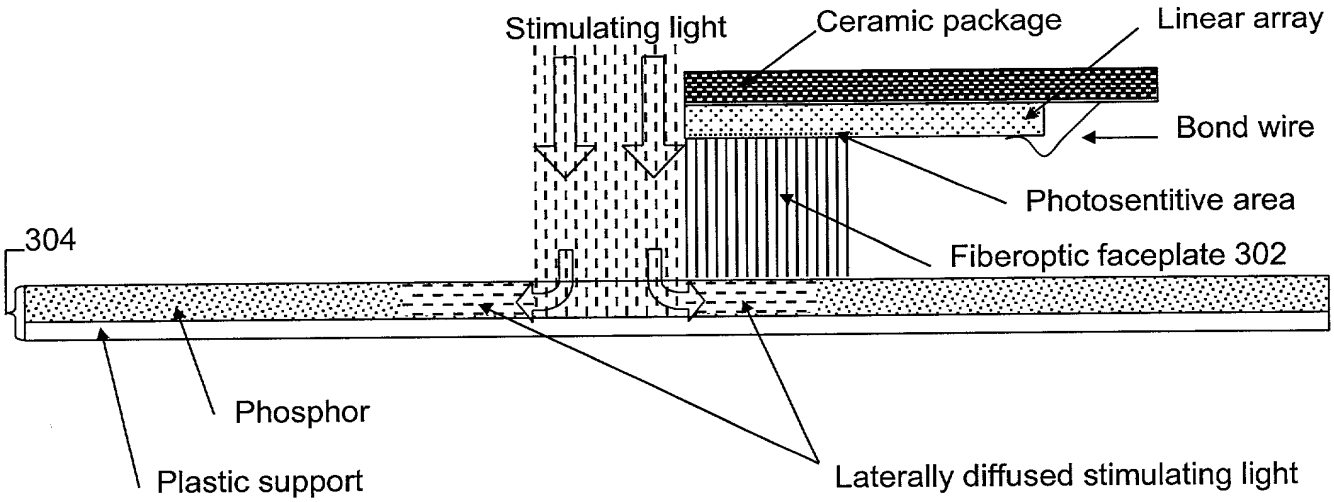

Stimulating light
Ceramic package
Linear array
Bond wire
Photosentitive area
Fiberoptic faceplate 302
304
Phosphor
Plastic support
Laterally diffused stimulating light

Fig.3

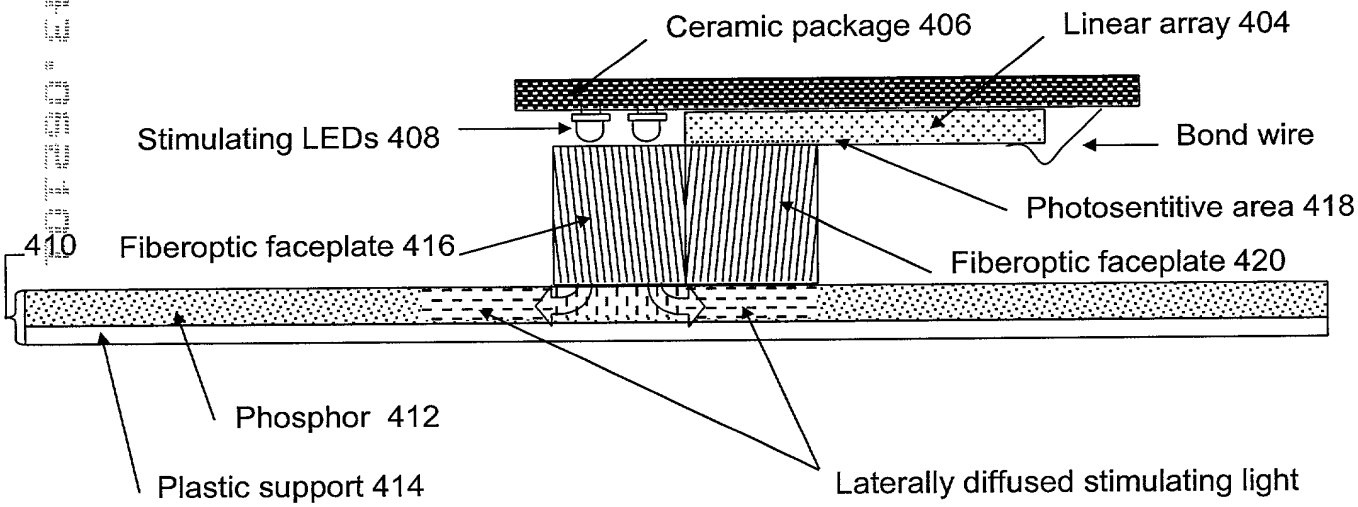

Ceramic package 406
Linear array 404
Stimulating LEDs 408
Bond wire
Photosentitive area 418
410
Fiberoptic faceplate 416
Fiberoptic faceplate 420
Phosphor 412
Plastic support 414
Laterally diffused stimulating light

Fig.4

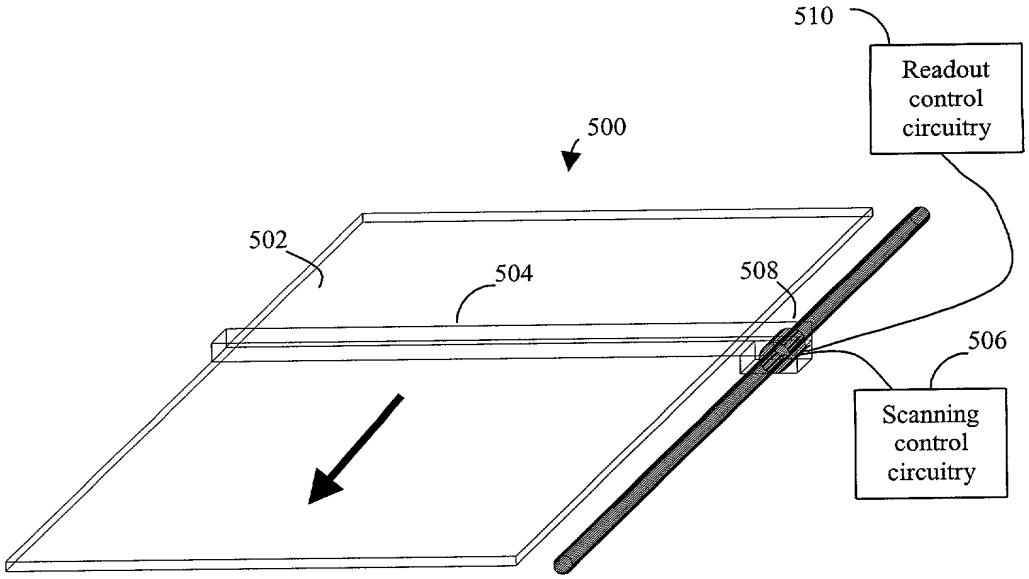

510
Readout control circuitry
500
502
504
508
506
Scanning control circuitry

Fig.5

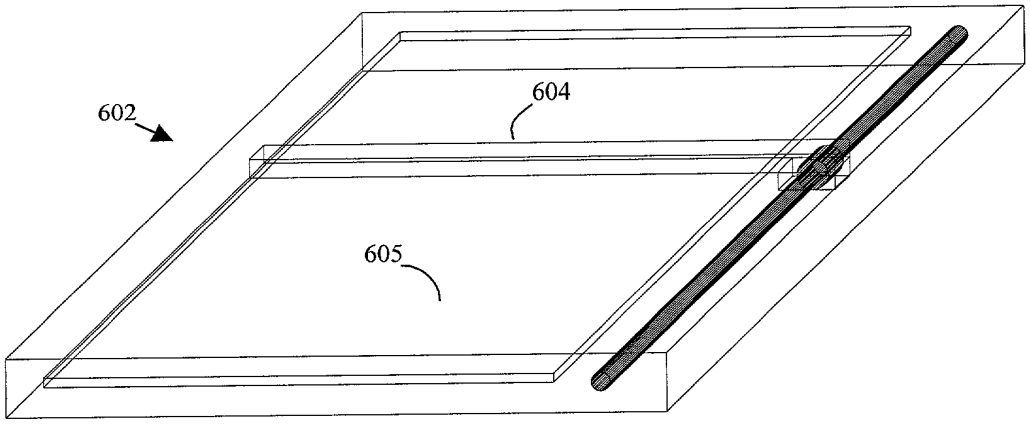

602
604
605

Fig.6

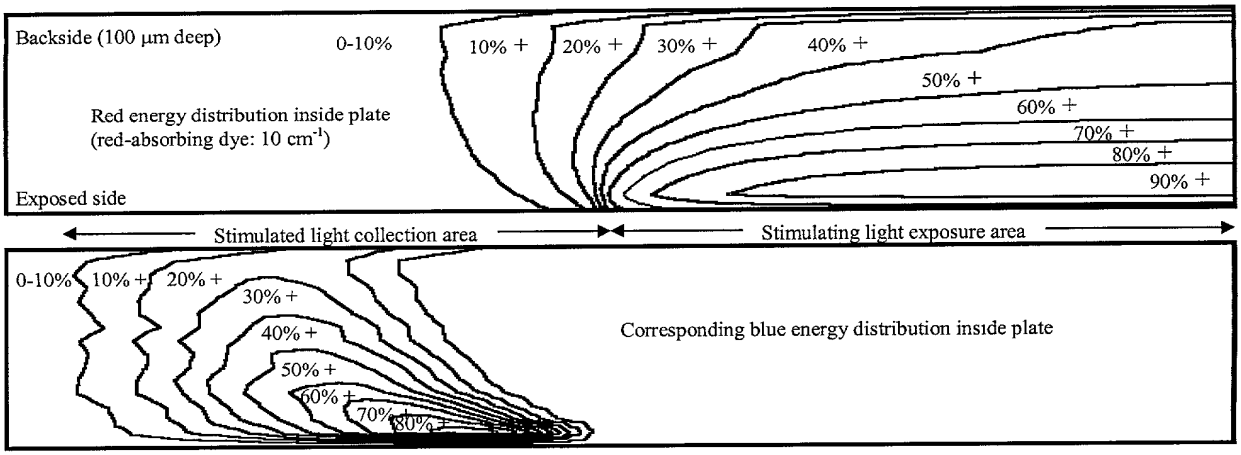


Fig. 7a

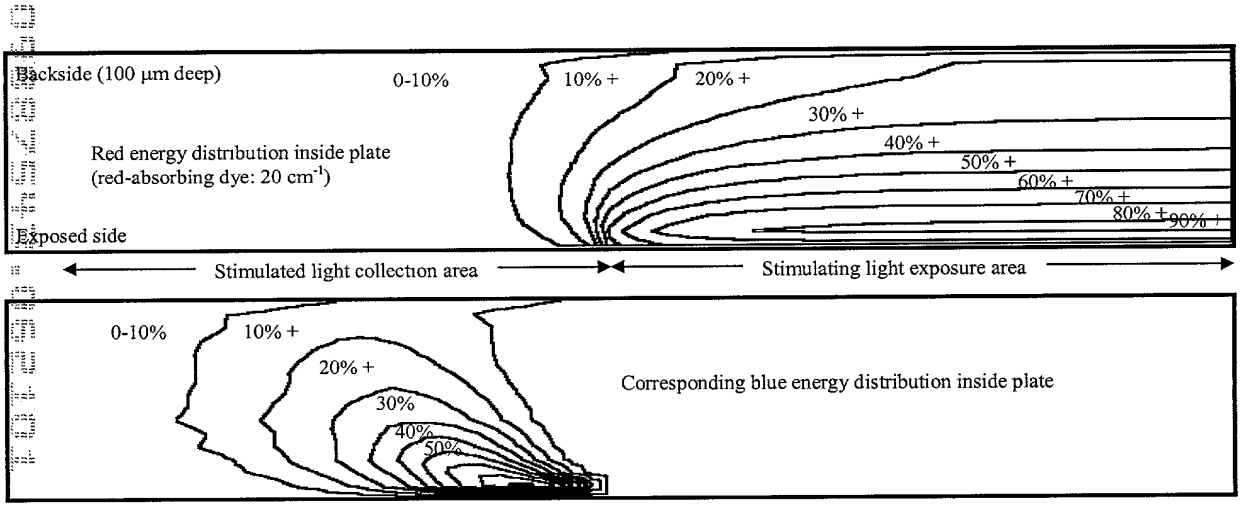


Fig. 7b

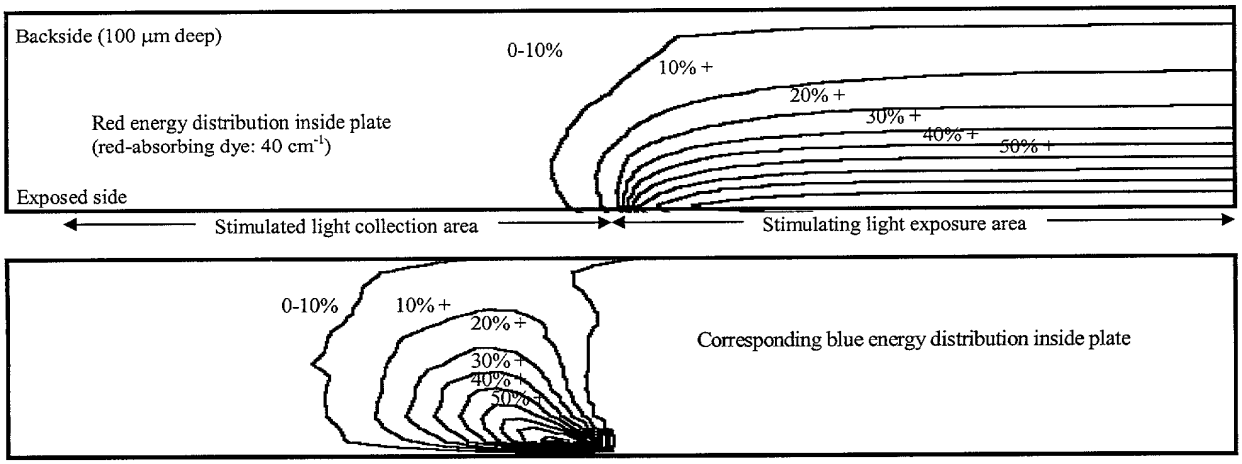


Fig. 7c

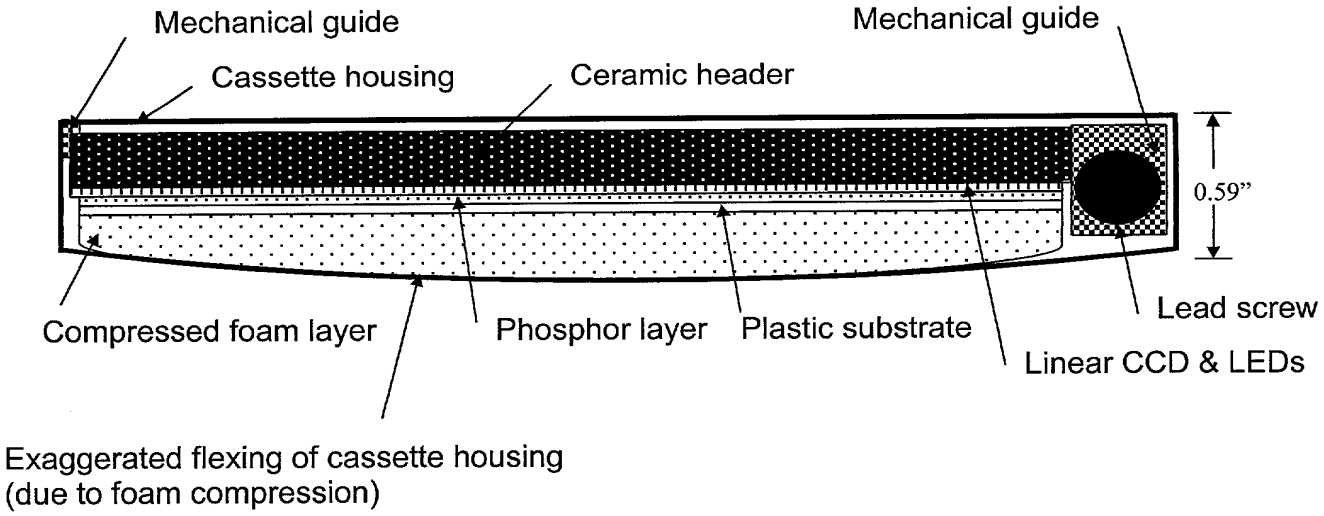

Mechanical guide
Cassette housing
Ceramic header
Mechanical guide
0.59"
Compressed foam layer
Phosphor layer
Plastic substrate
Linear CCD & LEDs
Lead screw
Exaggerated flexing of cassette housing
(due to foam compression)

Fig. 9

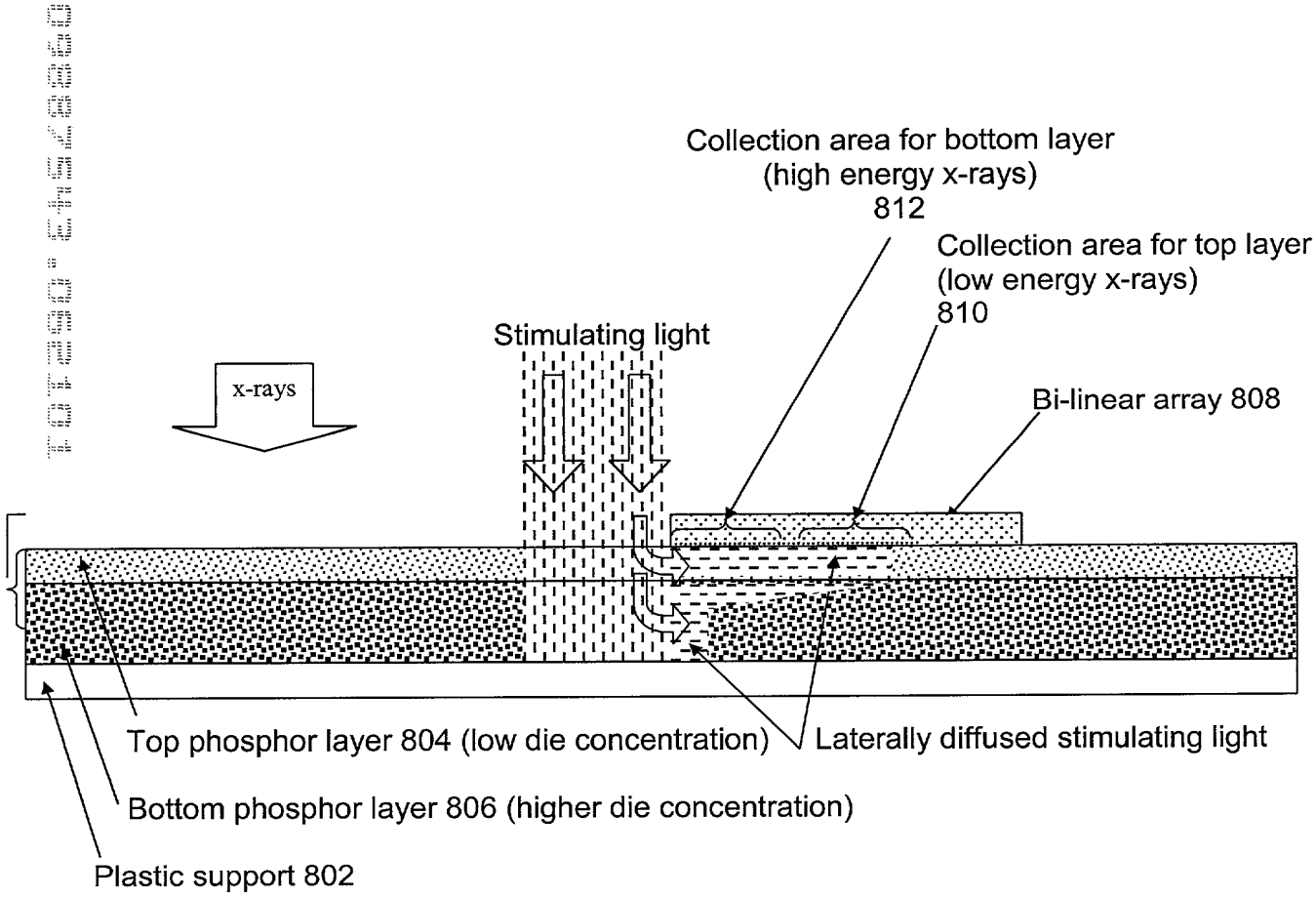
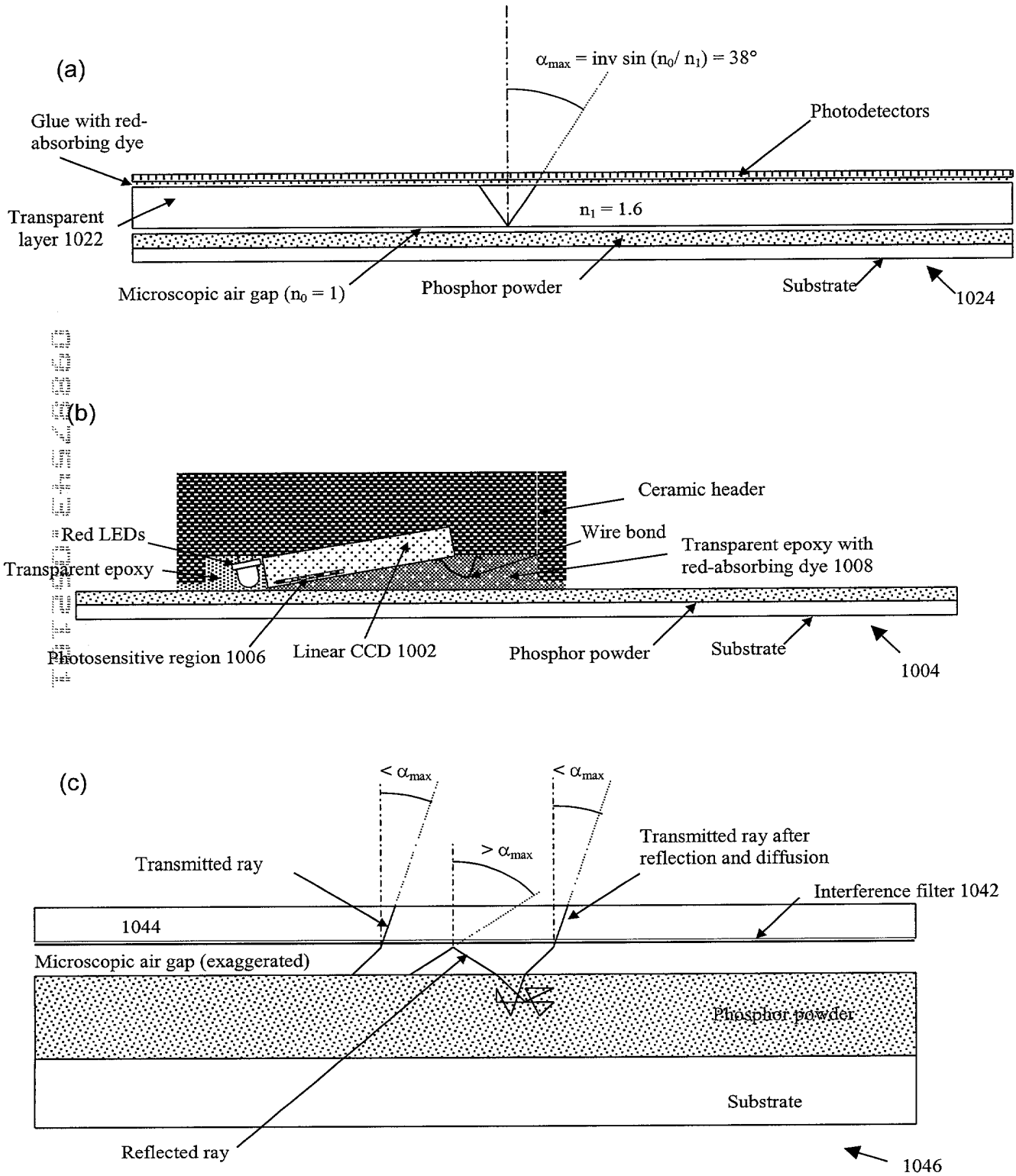
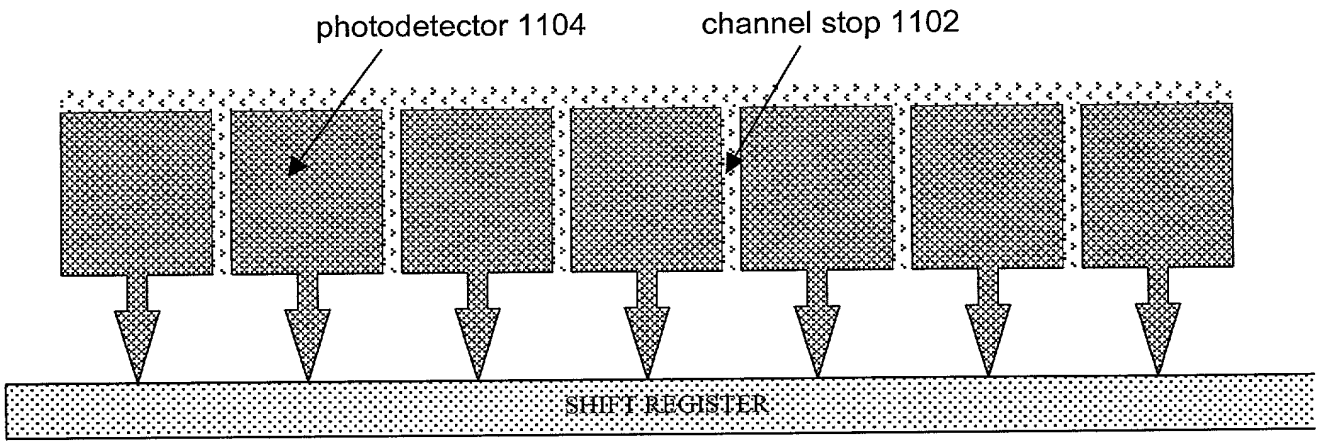

Collection area for bottom layer
(high energy x-rays)
812
Collection area for top layer
(low energy x-rays)
810
Stimulating light
x-rays
Bi-linear array 808
Top phosphor layer 804 (low die concentration)
Laterally diffused stimulating light
Bottom phosphor layer 806 (higher die concentration)
Plastic support 802

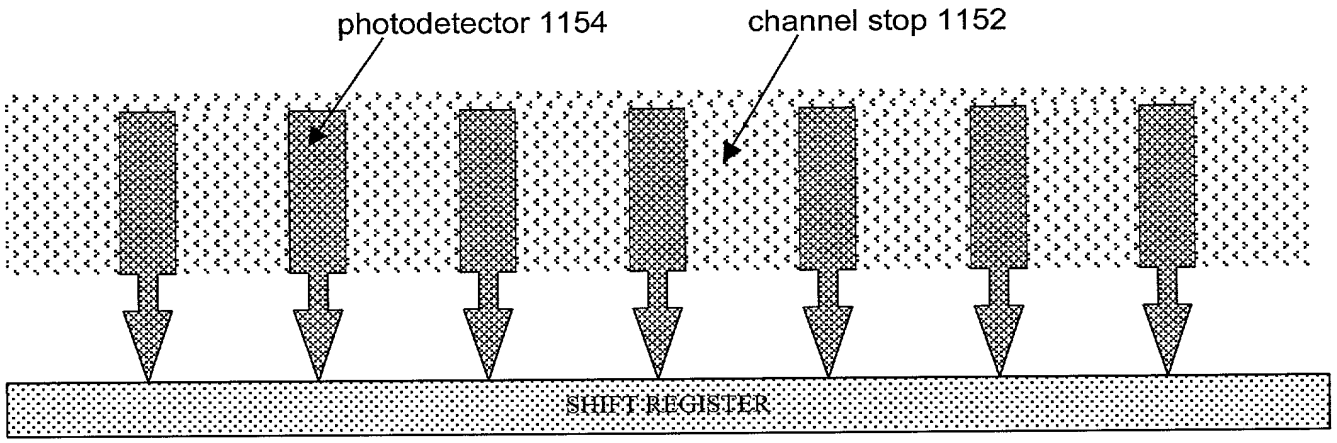
Fig. 8

Fig.10


(a)
α_{max} = inv sin (n_0/ n_1) = 38°
Glue with red-absorbing dye
Photodetectors
Transparent layer 1022
n_1 = 1.6
Microscopic air gap (n_0 = 1)
Phosphor powder
Substrate
1024
(b)
Ceramic header
Red LEDs
Wire bond
Transparent epoxy with red-absorbing dye 1008
Transparent epoxy
Photosensitive region 1006
Linear CCD 1002
Phosphor powder
Substrate
1004
(c)
< α_{max}
< α_{max}
> α_{max}
Transmitted ray after reflection and diffusion
Transmitted ray
Interference filter 1042
1044
Microscopic air gap (exaggerated)
Phosphor powder
Substrate
Reflected ray
1046



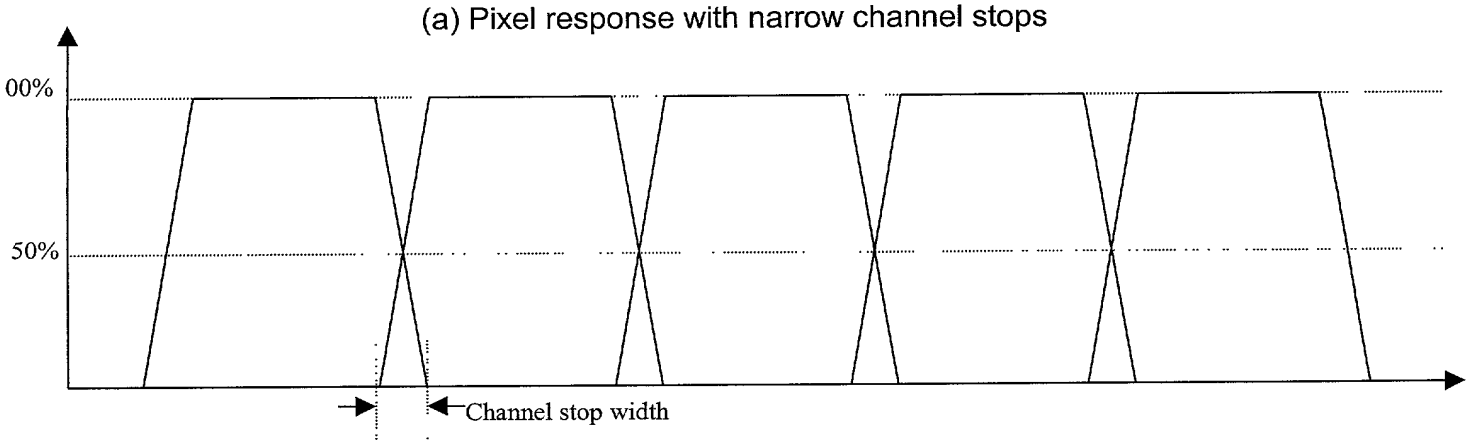
(a) Prior art



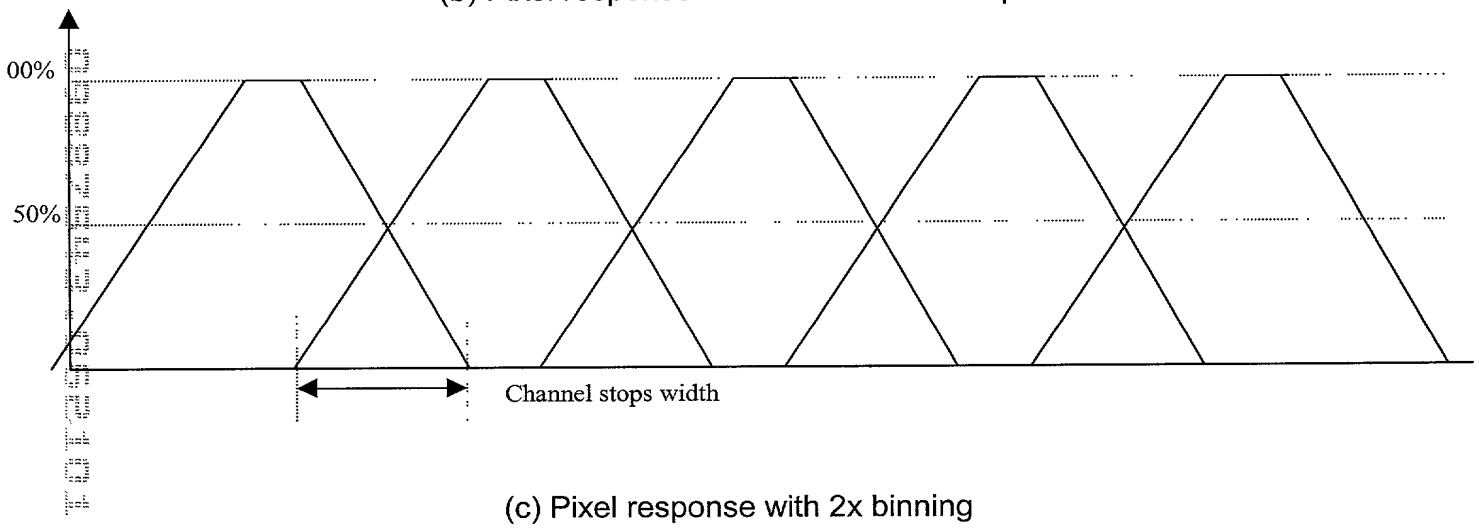
(b) design

Fig. 11

(a) Pixel response with narrow channel stops



(b) Pixel response with wide channel stops



(c) Pixel response with 2x binning

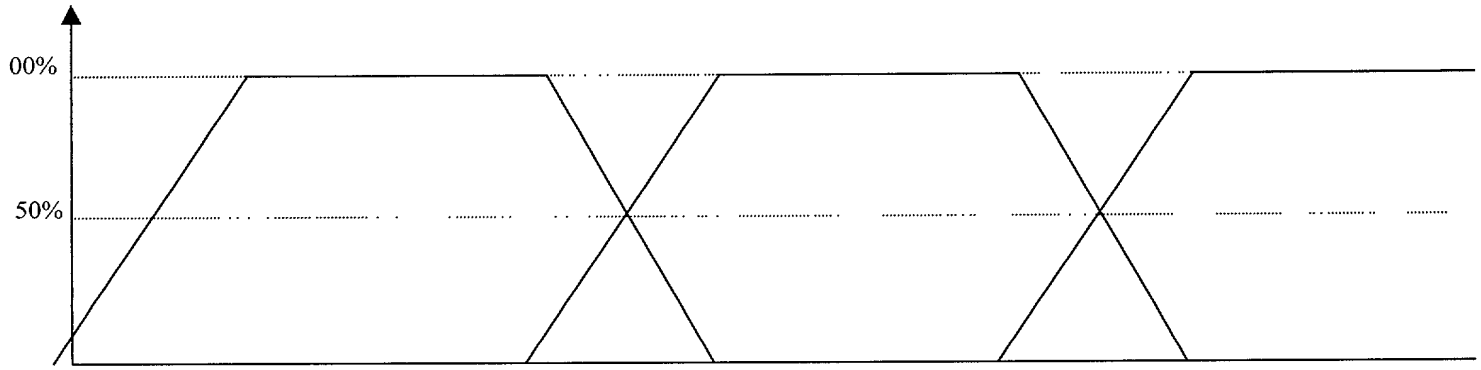
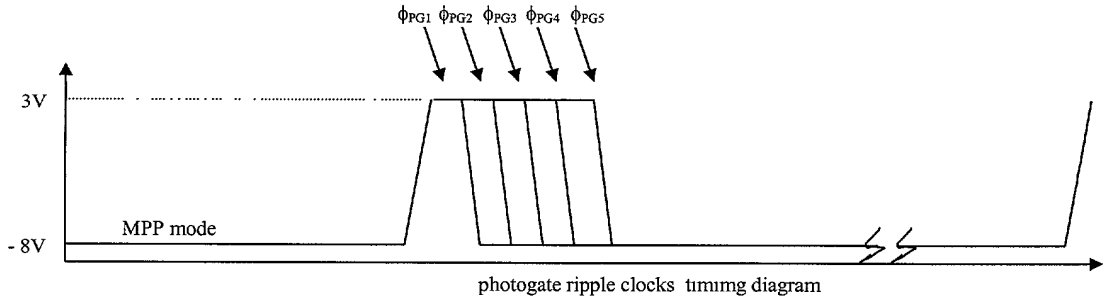


Fig. 12

Fig. 13


ϕ_{PG1} ϕ_{PG2} ϕ_{PG3} ϕ_{PG4} ϕ_{PG5}
3V
MPP mode
- 8V
photogate ripple clocks timing diagram

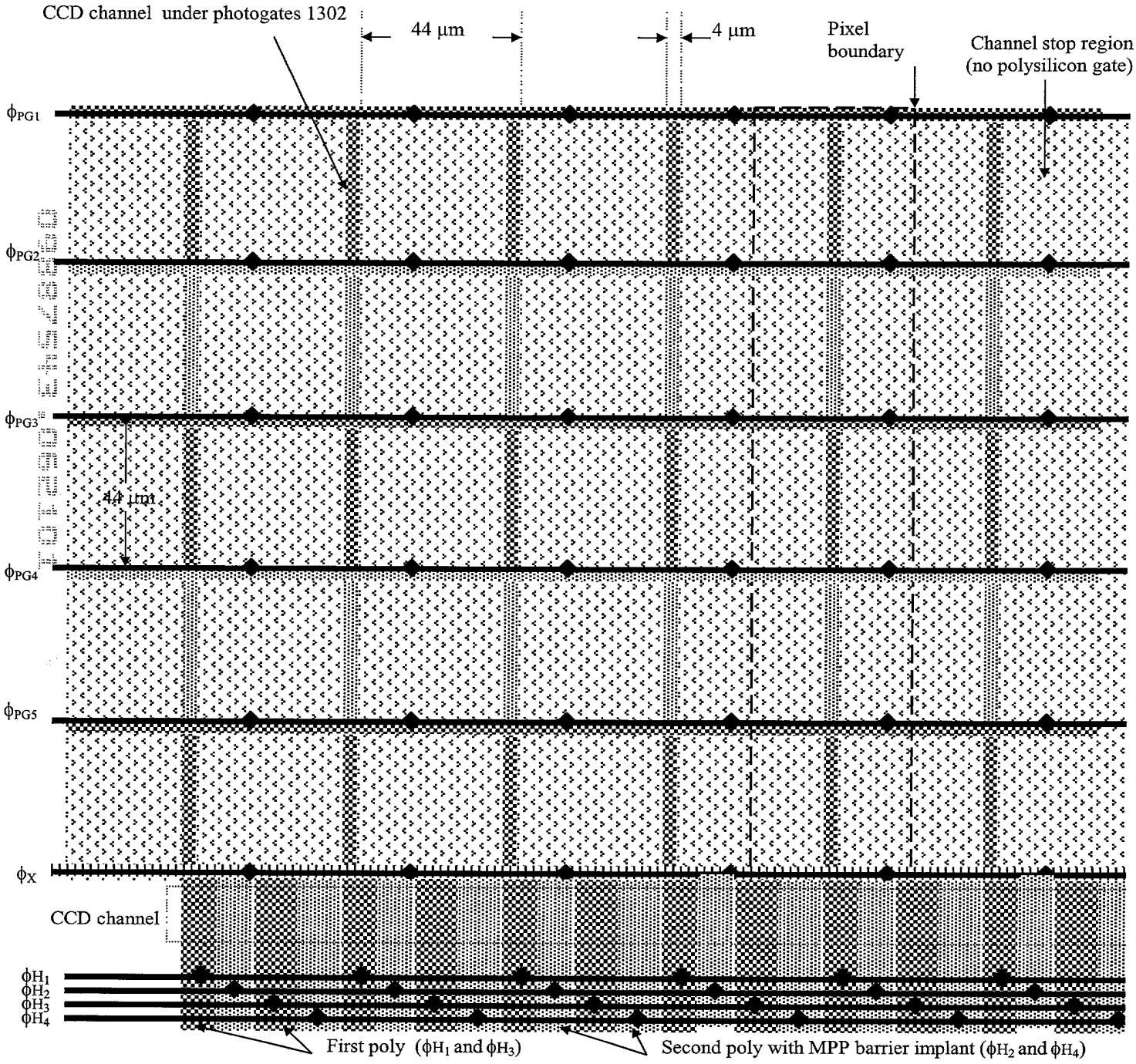
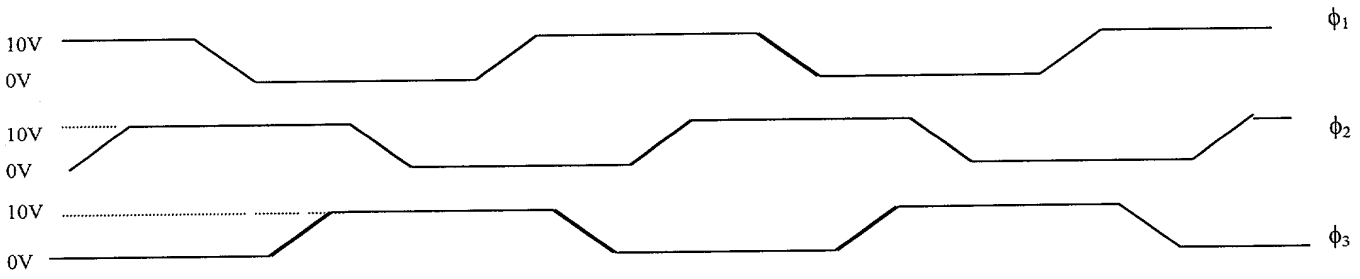
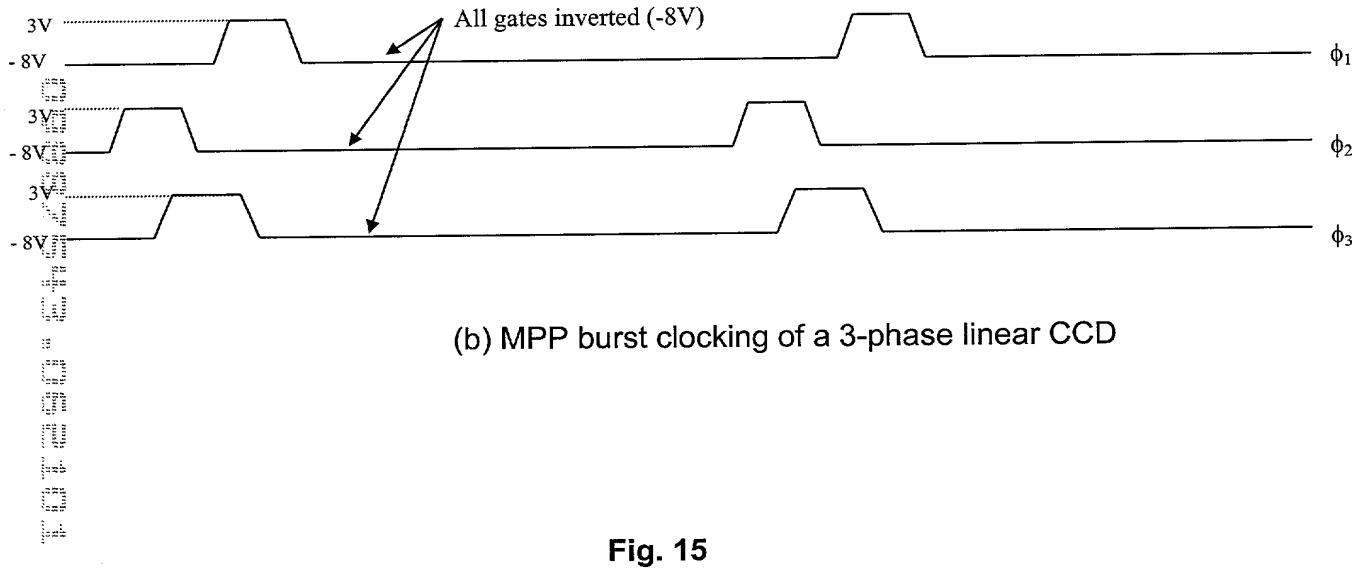

CCD channel under photogates 1302
44 µm
4 µm
Pixel boundary
Channel stop region (no polysilicon gate)
ϕ_{PG1}
ϕ_{PG2}
ϕ_{PG3}
4.4 µm
ϕ_{PG4}
ϕ_{PG5}
ϕ_X
CCD channel
ϕH_1
ϕH_2
ϕH_3
ϕH_4
First poly (ϕH_1 and ϕH_3)
Second poly with MPP barrier implant (ϕH_2 and ϕH_4)

Fig. 14

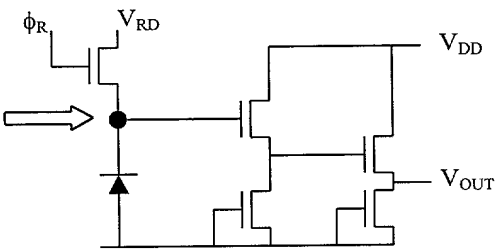


(a) Non-MPP continuous clocking of a 3-phase linear CCD

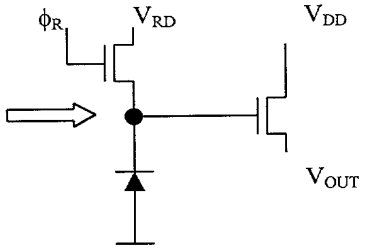


(b) MPP burst clocking of a 3-phase linear CCD

Fig. 15



(a) dual-stage amplifier for linear CCD (prior art)



(b) single-stage amplifier for linear CCD

Fig. 16

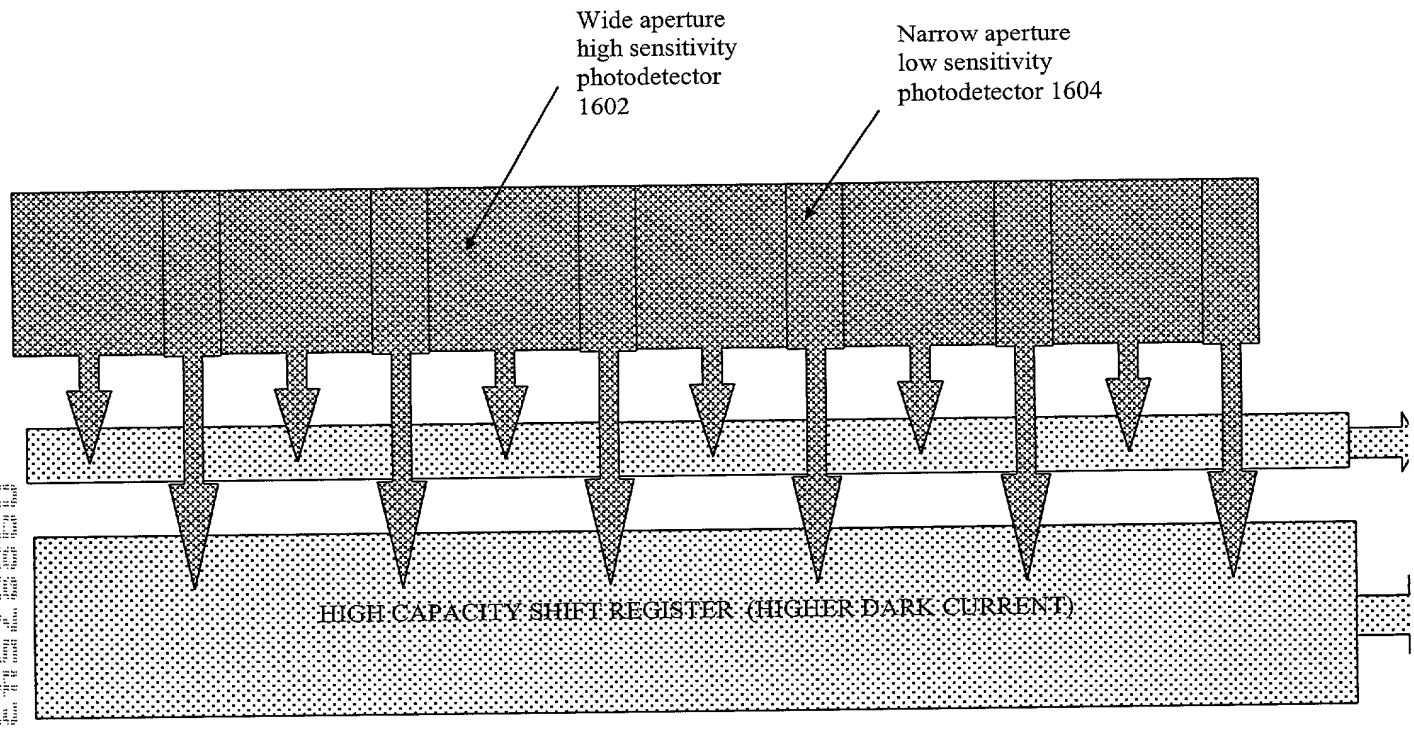

Wide aperture
high sensitivity
photodetector
1602
Narrow aperture
low sensitivity
photodetector 1604
HIGH CAPACITY SHIFT REGISTER (HIGHER DARK CURRENT)

Fig. 17

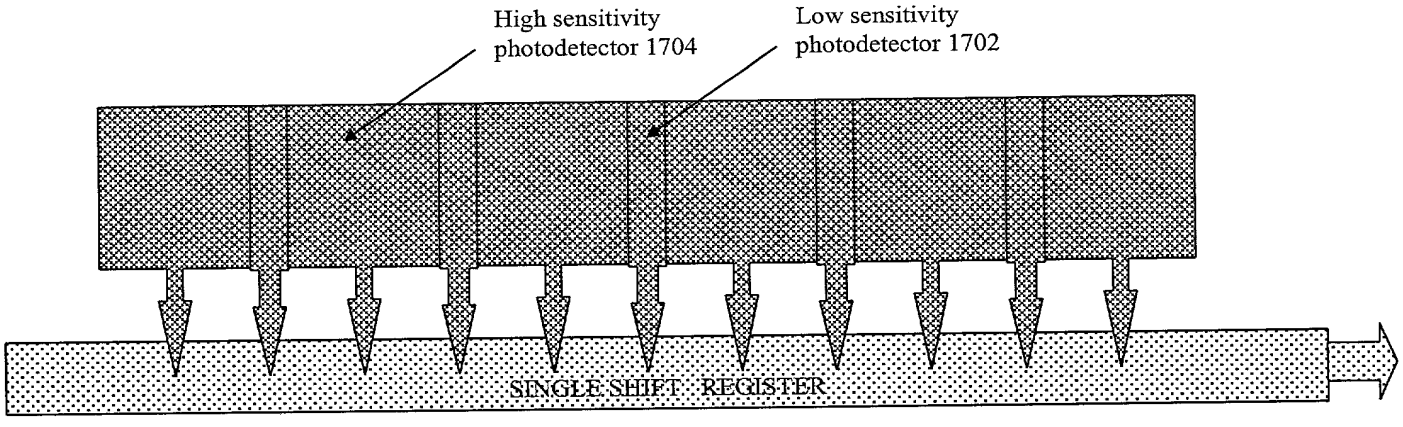
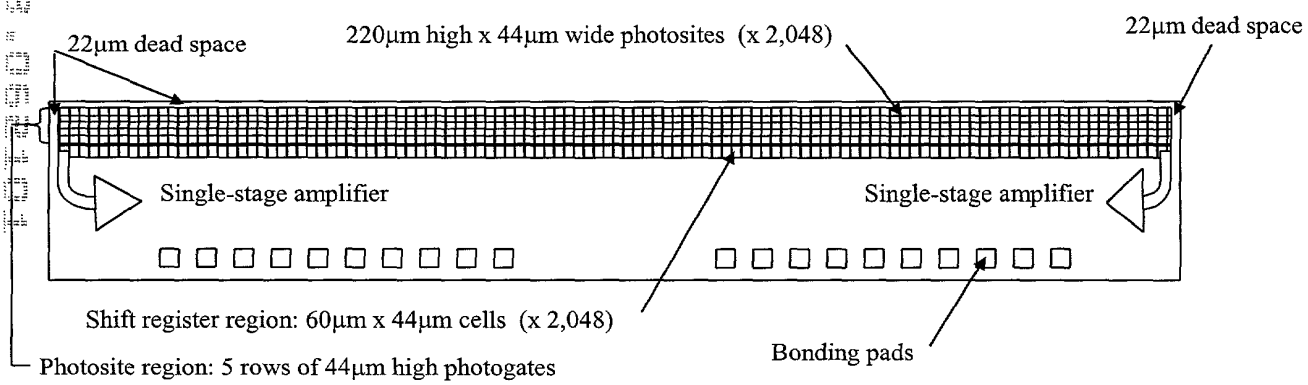

High sensitivity
photodetector 1704
Low sensitivity
photodetector 1702
SINGLE SHIFT REGISTER

Fig. 18

Linear CCD specifications for storage-phosphor image plate reading

CCD architecture	Linescan (photosites & single register)
Photosite dimension	220 μm high x 44 μm wide (44 μm pitch)
Photosite design	5 photogates/pixel (44μm high x 4μm wide)
Shift register cell dimension	60 μm x 44 μm on a 44 μm pitch
Shift register design	2poly/2ϕ or 4ϕ switchable (with center split)
Shift register operation	Uni or bidirectional 2ϕ or 4ϕ (MPP mode)
Pixel count	2048 pixels
Die size	90.1 mm x 2.25 mm
Total dark current	< 20 pA/cm^2 MPP mode at 25°C
Shift register dark current (MPP mode)	25e$^-$/cell for 2ms integration at 40°C
Photogate charge transfer inefficiency (lag)	< 50e$^-$ at 1000 e$^-$ signal level
Well Capacity	10^6 e$^-$
Amplifier readout noise	5 e$^-$ at 250 kHz (single-stage amplifier)
Output configuration	1 or 2 outputs in split mode (opposite ends)
Effective Quantum Efficiency (uncoated)	> 50% at 400nm (63% QE x 80% FF)
Effective Quantum Efficiency (AR coated)	> 75% at 400nm (94% QE x 80% FF)
Open photogate fill factor (no poly coverage)	> 80%
Maximum readout speed	500 kHz
Binning	4x
Charge Transfer Efficiency	0.99999
Buttability	3 side buttable (< 22μm dead space)



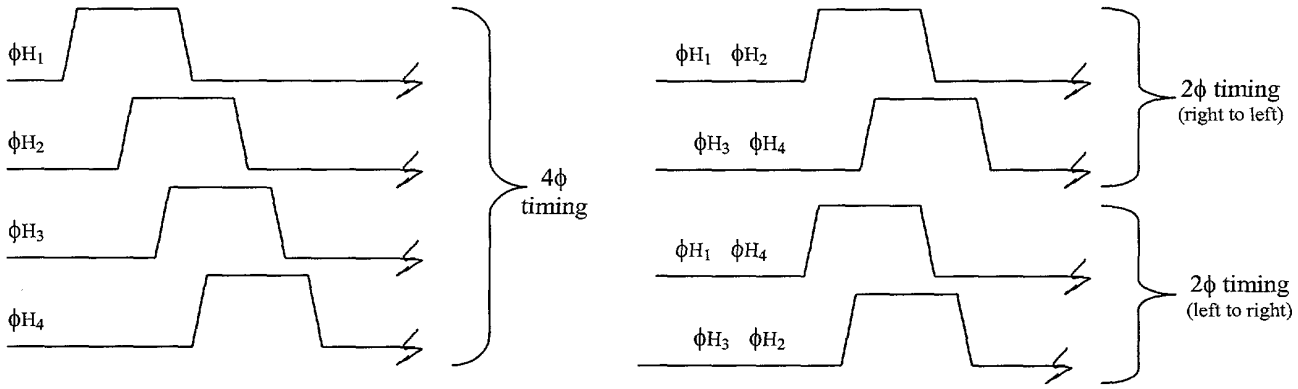


Fig. 19

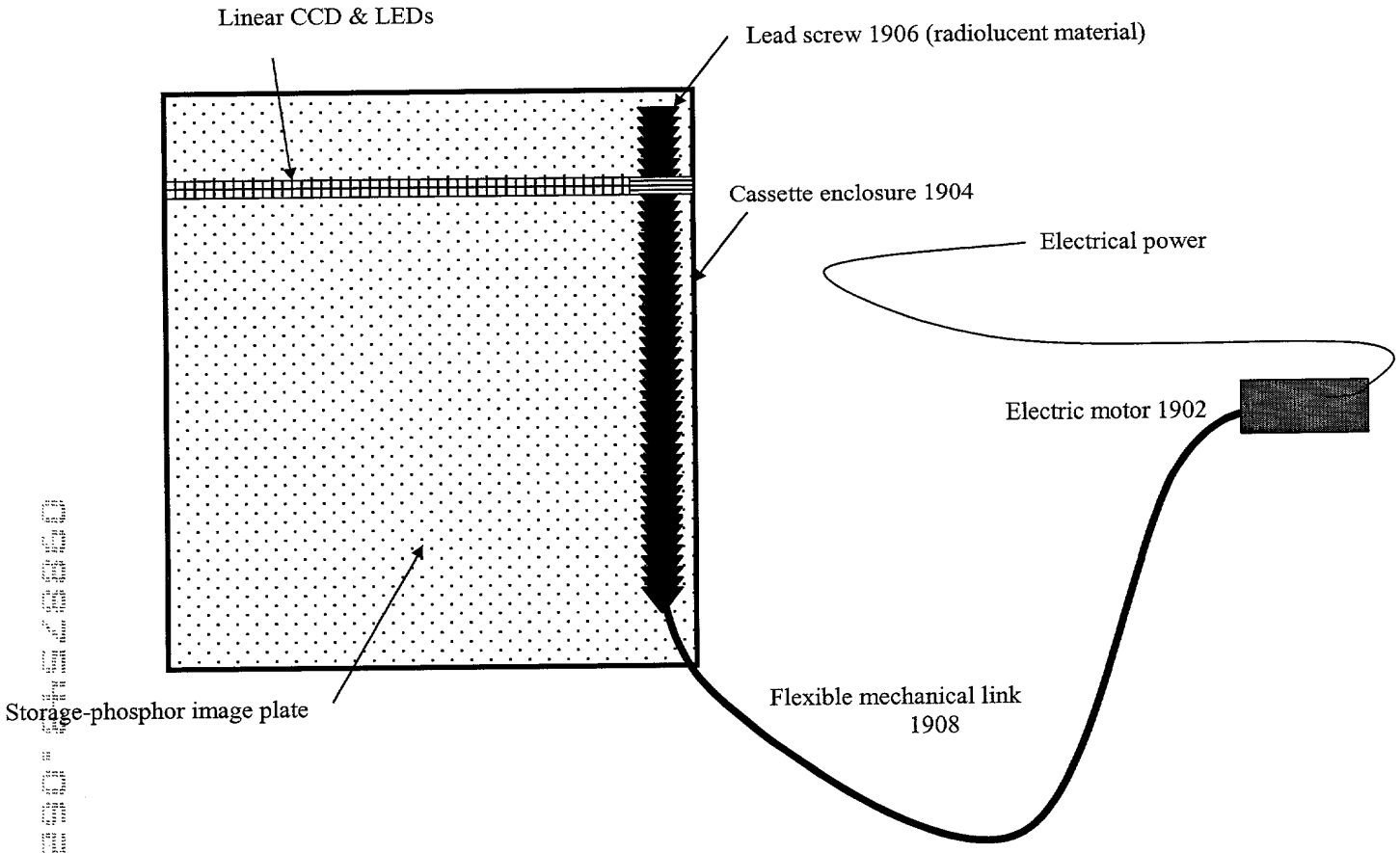
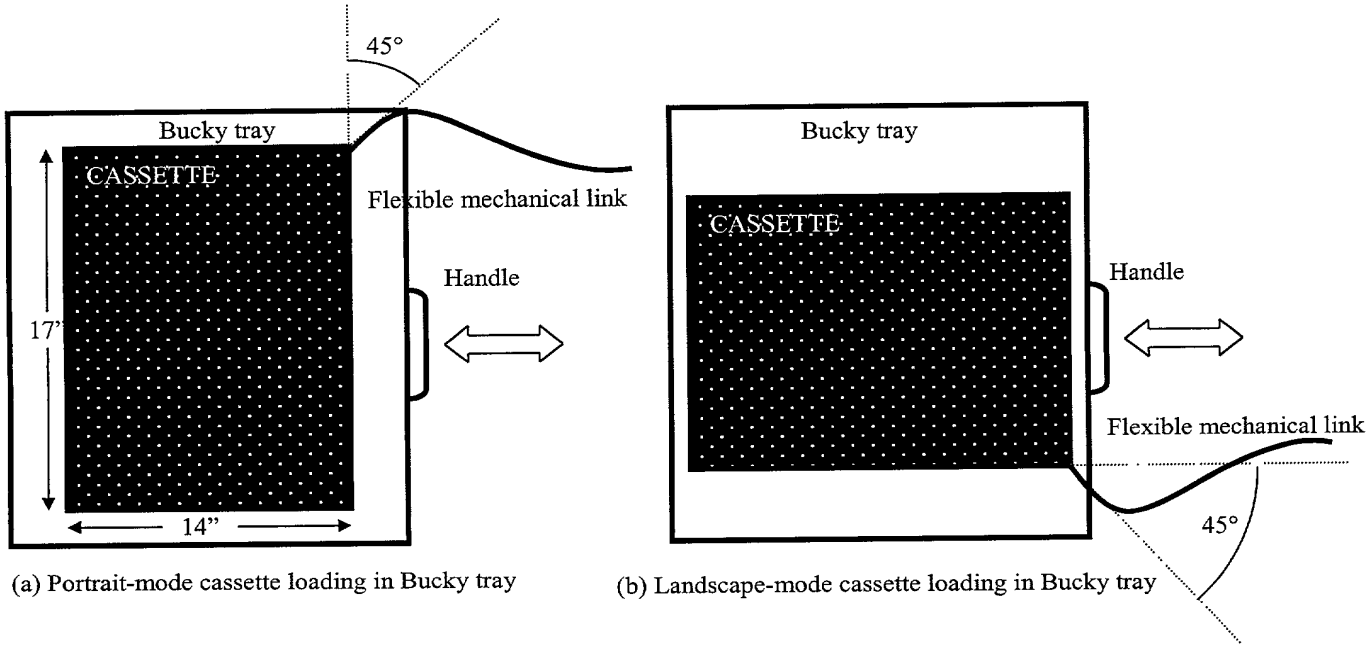


Fig. 20



(a) Portrait-mode cassette loading in Bucky tray

(b) Landscape-mode cassette loading in Bucky tray

Fig. 21

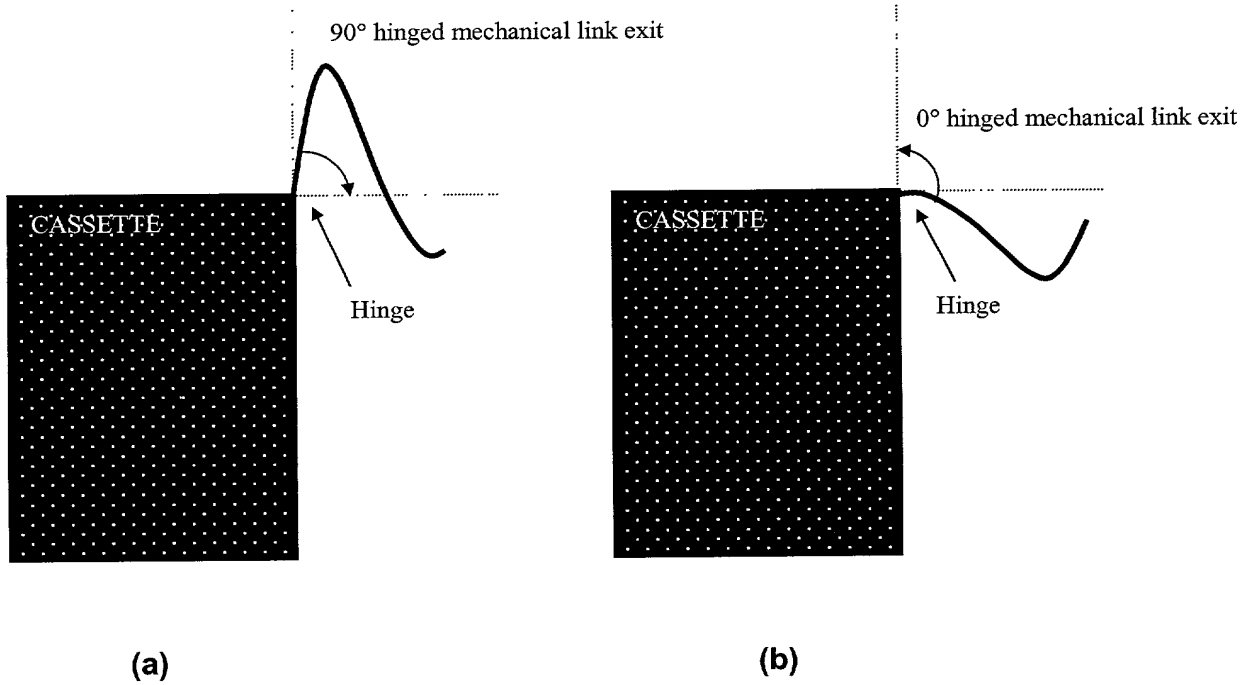

90° hinged mechanical link exit
CASSETTE
Hinge
0° hinged mechanical link exit
CASSETTE
Hinge
(a)
(b)

Fig. 22

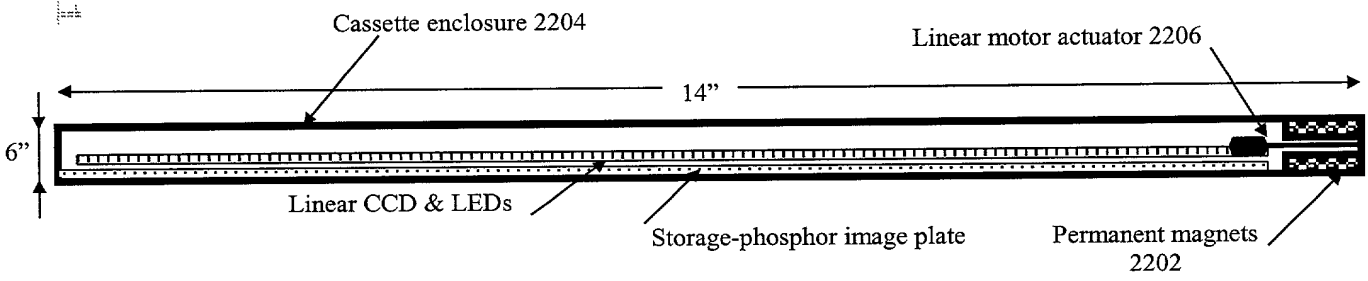

Cassette enclosure 2204
Linear motor actuator 2206
14"
6"
Linear CCD & LEDs
Storage-phosphor image plate
Permanent magnets
2202

Fig. 23

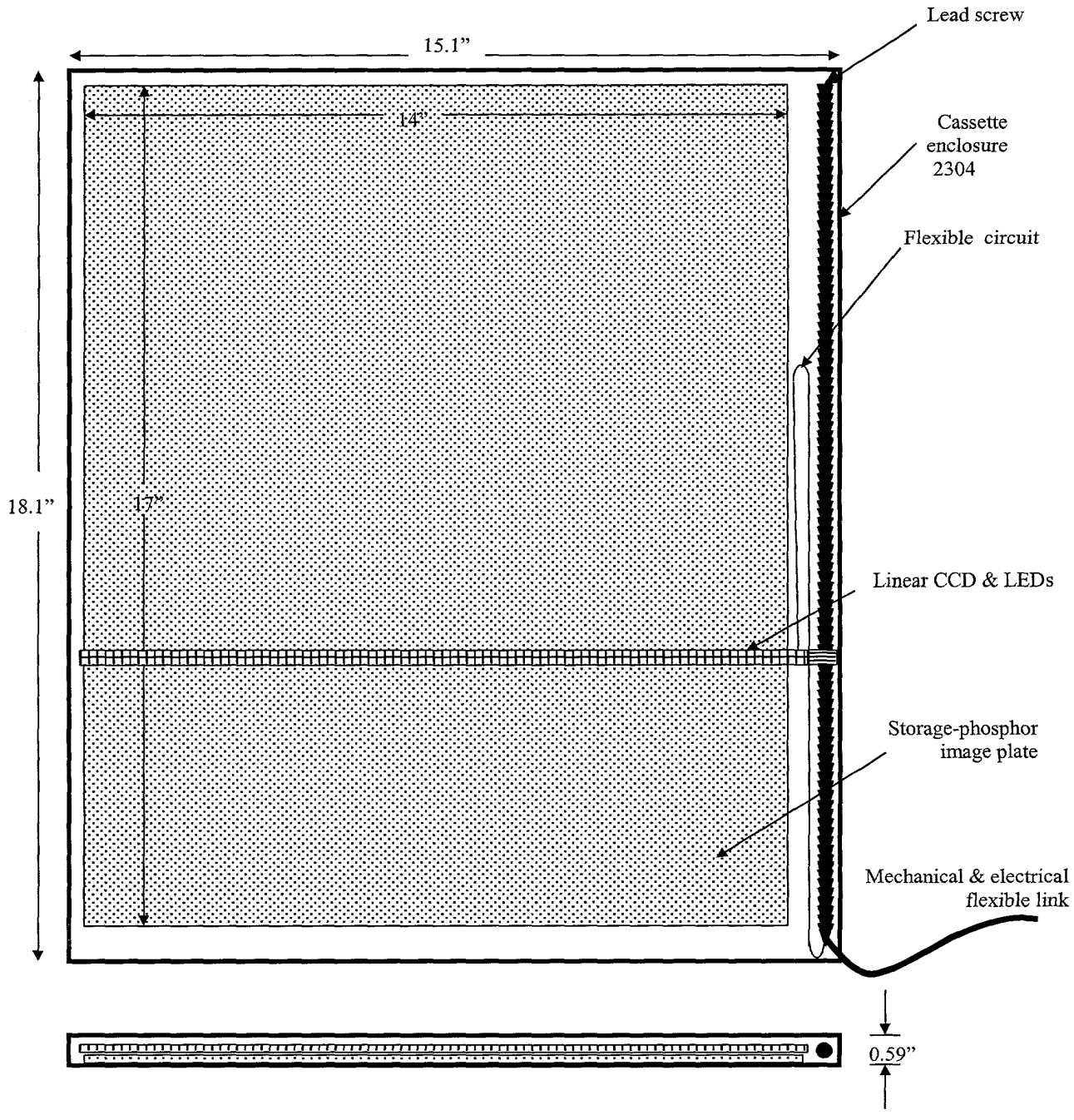
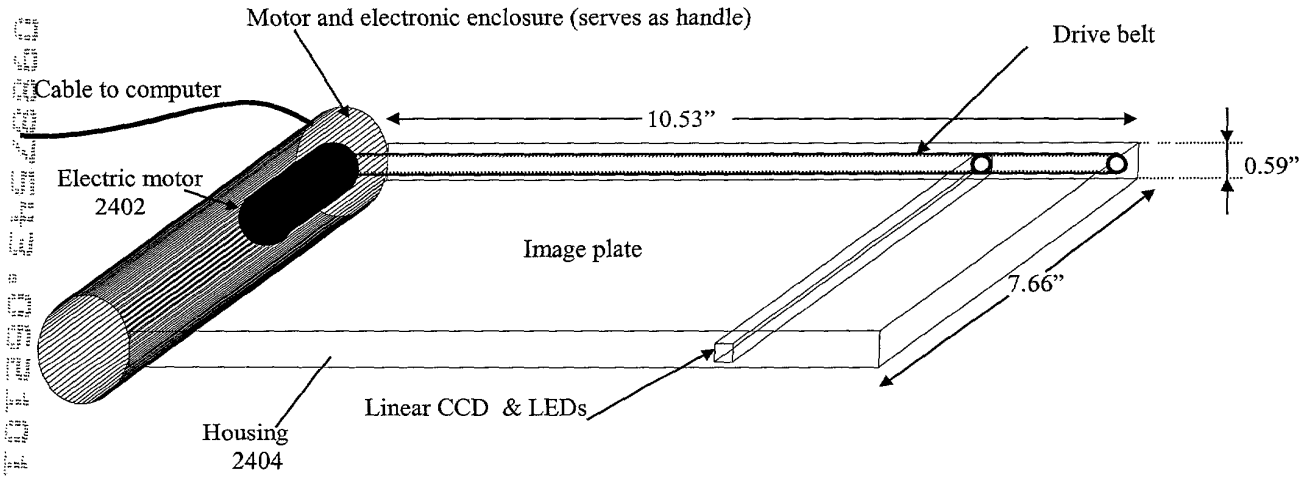

Lead screw
15.1"
14"
Cassette enclosure 2304
Flexible circuit
18.1"
17"
Linear CCD & LEDs
Storage-phosphor image plate
Mechanical & electrical flexible link
0.59"

Fig. 24



Mammography cassette enclosure (fits in standard 18cm x 24 cm bucky)